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(54) [Title of the Invention]

SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF  
AND IC CARD

(57) [Abstract] (modified version)

[Problems to be Solved]

To provide semiconductor device which can achieve a thin-profile.

[Means for Solving the Problem]

A semiconductor device including a wiring substrate 4 having an external terminal 21 on a rear surface, a semiconductor chip 3 fixed on a main surface of the wiring substrate, a connection means which electrically connects an electrode 10 of the semiconductor chip and wirings 5 and 6 of the wiring substrate 4, an insulator which covers a

conductive portion ranging from at least the periphery to an end surface of the semiconductor chip 3, and a conductive layer which electrically connects the electrode 10 of the semiconductor chip and the wiring of the wiring substrate. The semiconductor chip is approximately 5~30  $\mu\text{m}$  in thickness.

[Scope of Claim]

[Claim 1]

A semiconductor device characterized by comprising a wiring substrate having an external terminal on a rear surface, a semiconductor chip fixed on a main surface of the wiring substrate, a connection means electrically connecting an electrode of the semiconductor chip and a wiring of the wiring substrate, an insulator to cover a conductive portion ranging from at least the periphery of the semiconductor chip to an end surface, a conductive layer at which the electrode of the semiconductor chip and the wiring of the wiring substrate are electrically connected.

[Claim 2]

The semiconductor device according to the Claim 1 which is characterized in that the semiconductor chip is approximately 5~30  $\mu\text{m}$  thick.

[Claim 3]

The semiconductor device according to the Claim 1 which is characterized in that the wiring substrate, the insulator, and the conductive layer are formed with a heat-resistance material.

[Claim 4]

The semiconductor device according to the Claim 1 which is characterized in that the wiring substrate, the insulator, and the conductive layer are formed with a resin-based material having flexibility.

[Claim 5]

A method of manufacturing a semiconductor device which includes a wiring substrate having an external terminal on a rear surface, a semiconductor chip fixed on a main surface of the wiring substrate, a connection means electrically connecting an electrode of the semiconductor chip and a wiring of the wiring substrate which is characterized by comprising a step of forming the semiconductor chip with a thickness of approximately

5~30 $\mu$ m by removing a rear surface thereof, a step of fixing the semiconductor chip with an insulating adhesive layer on the wiring substrate interposed therebetween, a step of covering an exposed conductive portion ranging from an edge of the semiconductor chip to an end surface with an insulator, and a step of electrically connecting the electrode of the semiconductor chip and the wiring of the wiring substrate by printing method.

[Claim 6]

A method of manufacturing the semiconductor device according to Claim 5 which is characterized in that when the semiconductor chip is fixed on the wiring substrate with the insulating adhesive layer interposed therebetween, the semiconductor chip is mounted on the insulating adhesive layer and is pressed to stick the insulating adhesive layer out from the edge of the semiconductor chip after the insulating adhesive layer is printed on the wiring substrate.

[Claim 7]

An IC card in which a semiconductor device including an external terminal exposed to a card substrate is built-in with an adhesive agent interposed therebetween which is characterized by comprising a semiconductor device having a wiring substrate provided with the external terminal on a rear surface thereof, a semiconductor chip fixed on a main surface of the wiring substrate, and a connection means electrically connecting an electrode of the semiconductor chip and a wiring of the wiring substrate, wherein the IC card includes an insulator to cover a conduction portion from at least the periphery of the semiconductor chip to an end surface, a conductive layer electrically connecting the electrode of the semiconductor chip and a wiring of the wiring substrate, and is several tens of  $\mu$ m thick.

[Detailed Description of the Invention]

[0001]

The present invention relates to a semiconductor device, a manufacturing method thereof, and an IC card. In particular, an effective technique which is applied to manufacture of a thin-profile semiconductor device.

[0002]

## [Related Art]

For one structure of an IC card, a structure where a module provided with a transfer-molded LSI chip embedded in a card of 0.76 mm thick has been known, as described in p.56~p.62 of *NIKKEI MICRO DEVICE* of March issue in 1988, which is published on March 1 in the same year, by Nikkei Business Publication. The above module (a semiconductor device) is formed such that an electrode of the semiconductor chip and a wiring of a wiring substrate is electrically connected to each other by wire bonding, and then the semiconductor chip and wiring and the like are transfer-molded after the semiconductor chip is mounted on a face of the wiring substrate made of glass-epoxy resin by COB (chip on board). A contact electrode terminal serving as an external terminal is provided on a rear face of the wiring substrate. This contact electrode terminal is electrically connected to a wiring on the main surface of wiring substrate via a through hole filled with a conductor, which is provided in the wiring substrate.

## [0003]

Meanwhile, in p.26~p.27 and p.38~p.39 of *The Newest Hybrid-mounting technique* issued on May 15 in 1988 by Kogyo Chosakai Publishing, Inc., cases such as an PWC (Printed Wiring Connection) for an IC card and a hybrid IC using a connection conductive paste instead of a bonding wire are described in order to achieve improvement of productivity and high density.

## [0004]

An assemblage using the former PWC is performed such that an LSI chip is inserted into an aperture portion of a polycarbonate sheet and embedded in the PWC. After that, a printing connection wiring is formed over a surface of the polycarbonate sheet and a portion where the LSI is embedded by printing. Its upper and lower surfaces are covered with a polycarbonate film.

## [0005]

In a case of the latter hybrid IC, an IC chip is embedded within an Al substrate using an epoxy resin, and the IC chip is interconnected using a photosensitive conductive paste and insulating paste.

[0006]

Note that in these structures, a semiconductor chip is embedded in the wiring substrate; an electrode formed on a surface of the wiring substrate and the semiconductor chip are situated on almost the same surface. Therefore, in formation of conductive pattern (a conductive layer) for connection, no step is generated between the electrode of the semiconductor chip and the wiring of the wiring substrate.

[0007]

[Problems to be Solved by the Invention]

In a COB semiconductor device (a module), due to its structure, an electrode of a semiconductor chip and a wiring of a wiring substrate are connected by a wire bonding; a semiconductor device becomes thick by the height of the wireloop and mechanical strength of recess portion becomes low.

[0008]

By contrast, in a structure where a semiconductor chip is embedded in a hole portion provided in the wiring substrate, a method that a surface of a wiring of the wiring substrate and an electrode of a semiconductor chip are on the same surface is adapted; thus, no step is generated and the electrode of the semiconductor chip and the wiring are electrically connected by a printing method. However, it is difficult to manufacture the semiconductor device at low cost because of the following problems: embedding the semiconductor chip is troublesome; replacing (repairing) the semiconductor chip is very hard when it is a defective product. For low cost manufacture, it is essential to mount the semiconductor chip directly on the wiring substrate.

[0009]

Connecting the electrode of the semiconductor chip with the wiring at the conductive layer by a printing method prevents a thick conductive layer, whereby it can achieve a thin-profile semiconductor device (a module).

[0010]

Accordingly, the present invention intends to mount a semiconductor chip on a main surface of a wiring substrate and to connect an electrode of the semiconductor chip with a wiring by printing method. On the other hand, a conventional semiconductor chip,

that is, an LSI chip of 200  $\mu\text{m}$ ~500  $\mu\text{m}$  thick generates a step between an electrode of a semiconductor chip and a wiring, which shows that connection is insufficient due to frequent generation of printing crack at the step portion in printing a conductive paste.

[0011]

An object of the present invention is to provide a semiconductor device which can achieve a thin-profile, and a manufacturing method thereof.

[0012]

Another object of the present invention is to provide an IC card which can achieve improvement in mechanical strength of a card substrate.

[0013]

The above and another object, and a novel feature will be obvious from a description of the specification and attached drawings.

[0014]

A typical outline of the invention disclosed in this application is as follow. That is, the semiconductor device of the present invention includes the wiring substrate having the external terminal on the rear surface, the semiconductor chip fixed on the main surface of the wiring substrate, the connection means electrically connecting the electrode of the semiconductor chip and the wiring of the wiring substrate, the insulator covering the conductive portion ranging from at least the edge of the semiconductor chip to the end surface, and the conductive layer electrically connecting the electrode of the semiconductor chip and the wiring of the wiring substrate. The semiconductor chip is approximately 5~30  $\mu\text{m}$  thick. In addition, the wiring substrate, the insulator, and the conductive layer are formed with a heat-resistant material, and a flexible resin-based material.

[0015]

The semiconductor device of the present invention includes the wiring substrate having the external terminal on the rear surface, the semiconductor chip fixed on the main surface of the wiring substrate, the connection terminal electrically connecting the electrode of the wiring substrate, and the wiring of the wiring substrate. The method for manufacturing the semiconductor device of the present invention includes a step of

forming the semiconductor chip with a thickness of approximately 5~30  $\mu\text{m}$  by removing a rear surface thereof, a step of fixing the semiconductor chip with an insulating adhesive layer on the wiring substrate interposed therebetween, a step of covering the exposed conductive portion ranging from at least the edge of the semiconductor chip to the end surface with the insulator, a step of electrically connecting the electrode of the semiconductor chip and the wiring of the wiring substrate by a printing method. Further, when the semiconductor chip is fixed on the wiring substrate with the insulating adhesive layer interposed therebetween, the semiconductor chip is mounted on the insulating adhesive layer and is pressed to stick the insulating adhesive layer out from the edge of the semiconductor chip after the insulating adhesive layer is printed on the wiring substrate.

[0016]

An IC card of the present invention is an IC card in which a semiconductor device having an external terminal exposed to a card substrate is built in with an adhesive agent interposed therebetween. The IC card includes the semiconductor device having a wiring substrate provided with the external terminal on the rear surface thereof, the semiconductor chip fixed on the main surface of the wiring substrate, and the connection means electrically connecting the electrode of the semiconductor chip, the insulator to cover a conduction portion ranging from at least the periphery of the semiconductor chip to the end surface, the conductive layer electrically connecting the electrode of the semiconductor chip and a wiring of the wiring substrate, and the thickness of the semiconductor chip is approximately 5~30  $\mu\text{m}$ .

[0017]

[Operation]

By the means mentioned above, a thin-profile semiconductor device can be achieved such that the semiconductor chip which becomes several tens of  $\mu\text{m}$  thick is mounted on the wiring substrate, and the electrode of the semiconductor chip and the wiring of the wiring substrate are electrically connected at the conductive layer by printing.

[0018]

In the semiconductor device of the present invention, the electrode of the semiconductor

chip and the wiring of the wiring substrate are electrically connected at the conductive layer by printing, but a short-circuit between adjacent electrode portions of the semiconductor chip is prevented, because an insulator is provided under this conductive layer to cover an exposed conductive portion of an end surface from the periphery of the semiconductor chip.

[0019]

The semiconductor device of the present invention is formed of the wiring substrate, the insulator, and the conductive layer so that the heat-resistance of the semiconductor device becomes high.

[0020]

The semiconductor device of the present invention which is formed of the wiring substrate, the insulator, and the conductive layer which includes a resin-based material having flexibility, as such is high reliable in electrical connection between the electrode and the wiring of the semiconductor chip.

[0021]

By the manufacturing method of the semiconductor device of the present invention, the semiconductor chip is mounted on the wiring substrate after being thinned, and the electrode of the semiconductor chip and the wiring of the wiring substrate are connected at the conductive layer by printing; thus, a thin semiconductor substrate can be manufactured.

[0022]

In addition, using the manufacturing method of the semiconductor device of the present invention prevents a short-circuit between adjacent electrode portions of the semiconductor chip because the periphery of the semiconductor chip and the conductive portion of the end surface is covered with an insulator before the electrode of the semiconductor chip and the wiring of the wiring substrate are electrically connected by printing method.

[0023]

Moreover, when the semiconductor chip is fixed on the wiring substrate, the semiconductor chip is mounted on an insulating adhesive layer and is held to stick the



insulating adhesive layer out of an edge thereof after the insulating adhesive layer is printed on the wiring substrate. Accordingly, in printing of the conductive layer hereafter, the insulating adhesive layer exists between the semiconductor chip and the wiring so that a step between the semiconductor chip and the wiring substrate becomes low, which enables a stable electrical connection due to no generation of a crack and the like in the conductive layer at which the electrode of the semiconductor chip and the wiring are connected with each other.

[0024]

The IC card of the present invention improves mechanical strength of the card substrate because a semiconductor device which is embedded therein is a thin-profile, and a recess where the semiconductor device is embedded can be shallow.

[0025]

[Embodiment]

Hereinafter, an embodiment of the present invention is described with reference to drawings. FIG. 1 is a schematic cross-sectional view showing an outline of the semiconductor device in an embodiment of the present invention. FIG. 2~FIG. 6 are views showing pivots of the semiconductor device in each manufacturing step of the same in the embodiment. FIG. 2 is a schematic figure showing a state of forming an adhesive layer. FIG. 3 is a schematic cross-sectional view showing a state where a semiconductor chip is mounted. FIG. 4 is a schematic cross-sectional view showing a state where an insulator is formed. FIG. 5 is a schematic cross-sectional view showing a state where a conductive layer is formed. FIG. 6 is a schematic plain view showing a state where an insulator and a conductive layer are formed. FIG. 7 is a schematic cross-sectional view showing a pivot of an IC card in the embodiment, and FIG. 8 is a plain view of an IC card as in FIG. 7.

[0026]

A semiconductor device (a module) 1 of the embodiment is a module for an IC card embedded in an IC card 20 shown in FIG. 7 and FIG. 8, and has a structure including a wiring substrate 2 and a semiconductor chip 3 mounted on a main surface of this wiring substrate 2 as shown FIG. 1.

[0027]

The wiring substrate 2 is a printed substrate formed of a substrate body 4, wirings 5 and 6 which are provided on a main surface (a surface) and rear surface of the substrate body 4, and a through hole 7 penetrating the substrate body 4. The substrate body 4 is made of a so-called glass-epoxy substrate in which glass fiber is impregnated with an epoxy resin, or a high heat-resistant material impregnated with BT resin. This substrate body 4 has still a heat-resistance even at 80 °C or higher. Additionally, the substrate body 4 is approximately 0.3 mm in thickness. The wirings 5 and 6 are formed such that a copper foil with a thickness of approximately 35  $\mu\text{m}$ , which is attached to the rear surface of the substrate body 4, for example, is etched to be a desired pattern. Moreover, although not illustrated, electroplating process of Ni and Au is performed to the partial or entire surface of the wirings 5 and 6 in order that connection by the following printing appropriately proceeds.

[0028]

In addition, the through hole 7 is formed by drill process such that it penetrates the substrate body 4. On an inner-wall surface of this through hole 7, copper electroplating is performed. With a conductor 8 formed by this copper electroplating, the predetermined wirings 5 and 6 on front and rear surfaces of the substrate body 4 are electrically connected.

[0029]

The wiring 6 on a rear surface of the semiconductor device 1 in the embodiment forms a contact electrode terminal 21 serving as an external terminal of the IC card 20 as shown in FIG. 8.

[0030]

Additionally, on the main surface of the wiring substrate 2, the semiconductor chip 3 is fixed with an insulating adhesive layer 9 interposed therebetween. A rear surface side of the semiconductor chip 3 on which an active region is not provided is etched to remove a certain thickness, and for example, it is approximately 5~30 $\mu\text{m}$  thick. This is to prevent a large step difference between an electrode 10 provided on a surface of the semiconductor chip 3 and a height of the wiring 5 of the wiring substrate 2.

[0031]

In addition, as shown in FIG. 6, an insulator 11 formed of a flexible, heat-resistant material is provided to cover a conductive portion at least from the periphery to an end surface of the semiconductor chip 3. The insulator 11 is made from a resin-based material having a heat-resistance to 80 °C or higher. Also, over the insulator 11, a conductive layer 12 made of a flexible, heat-resistant material is provided. The conductive layer 12 electrically connects the electrode 10 of the semiconductor chip 3 and the wiring 5 of the wiring substrate 2. The conductive layer 12 is made of a resin-based material having a heat-resistance to 80 °C or higher. The insulator 11 and the conductive layer 12 are formed by a screen printing method.

[0032]

Note that in the surroundings of the semiconductor chip 3, a stuck-out portion of the insulating adhesive layer 9 at which the semiconductor chip 3 is connected to the substrate body 4 exists so that the insulator 11 provided on a portion to cover from the edge of the semiconductor chip 3 to the edge of the wiring 5 is formed flat because it lowers a step between the semiconductor chip 3 and the substrate body 4. Therefore, the conductive layer 12, which is provided on the flat insulator 11, becomes flat, is selectively thinned etc., thereby generating no cracks, which is inconvenient for electrical connection.

[0033]

Further, as shown in FIG. 6, the insulator 11 is provided to cover from the edge of the semiconductor chip 3 to a tip portion of the wiring 5, and the conductive layer 12 is provided on the insulator 11 thus to prevent short-circuit between adjacent electrodes 10.

[0034]

The semiconductor device 1 of the embodiment is greatly thinner than that which has a wire bonding structure because the semiconductor chip 3 is formed thin with a thickness of 5~30  $\mu\text{m}$  and the conductive layer 12 which connects the electrode 10 of the semiconductor 3 and the wiring 5 of the wiring substrate 2 is formed hugging on the wiring substrate 2 with the insulator 11 interposed therebetween. That is, in a case of a

conventional wire bonding structure, a semiconductor chip with a thickness of 200~500  $\mu\text{m}$  is mounted on the wiring substrate 2, and a wire with a loop height of approximately 150  $\mu\text{m}$  is connected to an electrode of this semiconductor chip. In addition, the wire and the semiconductor chip are covered with a package formed by transfer mold. Therefore, a height from a surface of the wiring substrate to an upper surface of the package becomes high: at least approximately 500  $\mu\text{m}$ . To the contrary, in a case of the semiconductor device of the embodiment, the semiconductor chip and the conductive layer are not covered with a package, and a height from a surface of the wiring substrate to an upper surface of the conductive layer is approximately 15~40 $\mu\text{m}$ , which is reduced single digit or more, and thus the semiconductor device 1 can be made thin. Accordingly, when the semiconductor device 1 of the embodiment is embedded in a recess 25 provided in a card substrate 23 with an insulating adhesive agent 24 interposed therebetween as shown in FIG. 7, the recess 25 can be made shallower about a hundred and several tens of  $\mu\text{m}$  than a conventional one so that mechanical strength of the card substrate 23 in which the recess 25 is provided is improved.

[0035]

The semiconductor device of the embodiment achieves effects below.

[0036]

(1) The semiconductor device of the embodiment achieves a thin-profile semiconductor device due to the semiconductor chip of approximately 5~30  $\mu\text{m}$  thick which is mounted on a main surface of the substrate body.

[0037]

(2) The semiconductor device of the embodiment achieves a thin-profile semiconductor device because connection between the electrode of the semiconductor chip and the wiring of the wiring substrate is performed at the conductive layer which is formed by printing method.

[0038]

(3) In the semiconductor device of the embodiment, the conductive layer at which the electrode of the semiconductor chip and the wiring of the wiring substrate are connected; the insulator serving as a base for the conductive layer, and the wiring

substrate are formed with a flexible resin-based material so that electrical connection between the electrode of the semiconductor chip and the wiring of the wiring substrate becomes high.

[0039]

(4) In the semiconductor device of the embodiment, the conductive layer at which the electrode of the semiconductor chip and the wiring of the wiring substrate are connected, the insulator serving as a base for the conductive layer, and the wiring substrate are formed with a heat-resistant material so that heat-resistance of the semiconductor device is improved.

[0040]

(5) In the semiconductor device of the embodiment, the insulator is provided under the conductive layer which connects the electrode of the semiconductor chip and the wiring of the wiring substrate so that an effect of preventing short-circuit between the conductive layers becomes high, which results in no generation of short-circuit between electrodes of the semiconductor device.

[0041]

Next, a manufacturing method of the semiconductor device 1 of the embodiment is described with reference to FIG. 2~FIG. 6. Firstly, as shown in FIG. 2, the wiring substrate 2 is prepared. This wiring substrate 2 is a printed substrate formed of the substrate body 4, the wirings 5 and 6 provided on a main surface (a front surface) and rear surface of this substrate body 4, and the through hole 7 penetrating the substrate body 4. The substrate body 4 is 0.3 mm thick, for example, and formed of a so-called glass epoxy substrate in which glass fiber is impregnated with epoxy resin, or a high-heat-resistant material (having a heat-resistance to 80 °C or higher) is impregnated with a BT resin. Electroplating is performed on an inner wall of the through hole 7, and the wirings 5 and 6 on a front and rear surface of the substrate body 4 are electrically connected at the predetermined position via the conductor 8 which is performed electroplating. Additionally, the wirings 5 and 6 are formed such that a copper foil with a thickness of approximately 15~35  $\mu\text{m}$ , which is attached to a front and rear surface of the substrate body 4, is etched to be a desired pattern, for example.

Also on surfaces of the wirings 5 and 6, although it is not shown, electroplating of Ni and Au is performed to the partial or entire surface of the same for appropriate connection by printing later described. Note that the wiring 6 is an external terminal and forms the contact electrode terminal 21 for the IC card in the embodiment.

[0042]

Then, as shown in FIG. 2, the insulating adhesive layer 9 is formed on a main surface of the substrate body 4 by a screen printing. That is, over the wiring substrate 2, a screen printing mask 15 on which an approximately same shape of transparent hole as the semiconductor chip 3 is positioned on a place where the semiconductor chip is mounted. A mask aperture portion does desirably not cover the wiring (a connection pad) formed on the printed substrate, and is desirably larger than the semiconductor chip. After that, an insulating paste layer 18 is formed such that a thermosetting adhesive paste 16 having an insulating characteristic is arranged on the screen printing mask 15, and then a squeegee 17 is moved to transfer the adhesive paste 16 on the wiring substrate 2.

[0043]

Meanwhile, a certain thickness of the rear surface side of the semiconductor chip 3 is grinded or etched to be removed, and processed to have a thickness of approximately 5~30  $\mu\text{m}$ .

[0044]

Next, as shown in FIG. 3, the semiconductor chip 3 with a thickness of approximately 5~30  $\mu\text{m}$  is put on the insulating paste layer 18 and softly pressed, which slightly sticks the insulating paste layer 18 under the semiconductor chip 3 out to the surroundings thereof and the insulating paste 18 soars to a lateral side (an end surface) of the semiconductor chip 3. This stuck-out portion 19 of the insulating paste layer 18 serves as an insulator of an end surface of the semiconductor chip 3 as well as lowering a step between a front surface of the substrate body 4 and an upper surface of the semiconductor chip 3. By a gradual lowering of a surrounding step of the semiconductor chip, reduction in defects of the conductive layer in a later step is remarkably improved.

[0045]

Subsequently, the wiring substrate 2 on which the semiconductor chip 3 is mounted is heated; the insulating paste layer 18 is cured and turned into the insulating adhesive layer 9; and the semiconductor chip 3 is fixed on the substrate body 4.

[0046]

Then, in order to secure insulation against an end surface of the insulating semiconductor chip 3 and flatness of a step, the insulator 11 is formed ranging from at least an edge of the semiconductor chip 3 to an edge of the wiring 5 with a thickness of a several  $\mu\text{m}$  to several tens of  $\mu\text{m}$  by screen printing and cure treatment similar to the above as shown in FIG.4 and FIG. 6. Namely, after the insulating paste is printed into the predetermined pattern by a screen printing, the insulator 11 is formed by heating the insulating paste to be cured. For the insulating paste, a paste superior in heat-resistance after being cured (having a heat-resistance to  $80^{\circ}\text{C}$  or higher), and in elasticity is selected. A resin-based paste is used as a paste of a such characteristic.

[0047]

Next, as shown in FIG. 5 and FIG. 6, the conductive layer 12 electrically connecting the electrode 10 of the semiconductor chip 3 and the wiring 5 of the wiring substrate 2 is formed by a screen printing method similar to the above. That is, the screen printing mask having an aperture portion for electrical connection of the wiring 5 of the wiring substrate 2 with the electrode 10 of the semiconductor chip 3 is stacked to the wiring substrate 2 and then a conductive paste is printed. The conductive paste is a paste in which a flake-like silver of  $1\ \mu\text{m}\sim 5\ \mu\text{m}$  size is dispersed with a concentration of 70 Wt %~80 Wt% into a thermosetting resin; after it is cured, it has a heat-resistance (even having a heat-resistance to  $80^{\circ}$  or higher) and an elasticity. By a cure treatment, the conductive layer 12 electrically connecting the electrode 10 and the wiring 5 is formed. This conductive layer 12 is several  $\mu\text{m}$  to several tens of  $\mu\text{m}$  in thickness.

[0048]

With the foregoing procedure, the semiconductor device 1 as shown FIG. 1 is manufactured. Using the manufacturing method of the semiconductor device in the embodiment achieves the following cures.

[0049]

(1) According to the manufacturing method of the semiconductor device in the embodiment, it is possible to mount the thin semiconductor chip on the wiring substrate, and to manufacture the thin-profile semiconductor device due to the conductive layer formed by a printing method by which the electrode of the semiconductor chip and the wiring are connected.

[0050]

(2) According to the manufacturing method of the semiconductor device in the embodiment, a printing crack is not generated and the conductive layer with the predetermined thickness can be formed, thereby improving a reliability of electrical connection when the conductive layer is formed by a printing method because a step between the semiconductor chip and the wiring substrate is lowered such that the insulating paste is pressed to stick out to the surroundings of the semiconductor chip at the stage of formation of the insulating adhesive layer which fixes the semiconductor chip before the conductive layer is formed.

[0051]

(3) According to the manufacturing method of the semiconductor device in the embodiment, it is possible to improve manufacturing yield and to achieve reduction in manufacturing cost of the semiconductor device because a printing crack is prevented as mentioned above.

[0052]

(4) According to the manufacturing method of the semiconductor device in the embodiment, it is possible to manufacture a semiconductor device superior in heat-resistance using the wiring substrate, the insulator, and the conductive layer each of which is formed of a heat-resistant material.

[0053]

(5) According to the manufacturing method of the semiconductor device in the embodiment, it is possible to manufacture a semiconductor device having an excellent resistance to a mechanical shock using the wiring substrate, the insulator, and the conductive layer each of which is formed of a flexible material.

[0054]



The semiconductor device 1 of the embodiment is built in the IC card 20 as shown FIG. 7 and FIG. 8. Namely, the semiconductor device 1 is embedded in the recess 25 of the card substrate 23 with a thickness of 0.76 mm of the IC card 20, and is fixed to the card substrate 23 with the adhesive agent 24. The wiring 6 of the semiconductor device 1 serves as an external terminal and forms the contact electrode terminal 21. In the IC card of the embodiment, the semiconductor device which is embedded is thin-profile so that a recess for embedding the semiconductor device can be shallow; thus, mechanical strength of the card substrate improves and strength to external forces such as bending of the semiconductor chip dramatically improves. Accordingly, the present invention achieves long life of the IC card.

[0055]

The above is a specific description of the present invention by the inventor based on the embodiment, but the present invention is not limited to the above embodiment, and thus it can be of course modified in various ways without departing from its scope. For example, in a case of the embodiment, although the insulator is provided to cover the end surface of the semiconductor chip, the insulator may be provided in advance on the end surface portion of the semiconductor chip instead. In addition, the thin-film conductive layer, which connects the electrode of the semiconductor chip and the wiring, can be formed by a method other than a printing method, for instance, vacuum vapor deposition or sputtering. Also, it may be a pre-formed film-like insulating sheet or a conductive sheet.

[0056]

In the above description, a case where the invention by the inventor is applied to an IC card manufacturing technology, a background of its application field is mainly described, but it is not limited to this. It is particularly effective when electronic components such as a resistance and capacitor are mounted on a substrate, or a variety of semiconductor chips including a hybrid IC and a passive element are connected altogether. The present invention is at least applicable to an electronic device in which a semiconductor device (a module) is built in.

[0057]

[Effect of the Invention]

Effects obtained by a typical invention disclosed in the present invention are simply described below. With use of the present invention, an ultra thin-profile semiconductor device can be provided.

[0058]

By the present invention, it can achieve a thin-profile semiconductor device which is embedded; thus, an IC card superior in reliability which can achieve improvement in mechanical strength of the card substrate in an embedding portion of the semiconductor device, and can dramatically improve strength to external forces including bending of the semiconductor chip and the like.

[Brief Description of the Drawings]

[FIG.1]

A schematic cross-sectional view showing an outline of a semiconductor device in an embodiment of the present invention.

[FIG.2]

A schematic view showing a state of forming an adhesive layer in a manufacturing method of the semiconductor device in the embodiment.

[FIG.3]

A schematic cross-sectional view showing a state where a semiconductor chip is mounted in a manufacturing method of the semiconductor device in the embodiment.

[FIG. 4]

A schematic cross-sectional view showing a state where an insulator is formed in a manufacturing method of the semiconductor device in the embodiment.

[FIG.5]

A schematic cross-sectional view showing a state where a conductive layer is formed in a manufacturing method of the semiconductor device of the embodiment.

[FIG.6]

A schematic cross-sectional view showing a state where an insulator and a conductive layer are formed in a manufacturing method of the semiconductor device of the embodiment.

[FIG.7]

A schematic cross-sectional view showing a pivot of the IC card of the embodiment.

[FIG.8]

A plain view showing the IC card of the embodiment.

[Reference Numerals]

1...semiconductor device, 2...wiring substrate, 3...semiconductor chip, 4... substrate body, 5,6...wiring, 7...through hole, 8...conductor, 9...insulating adhesive layer, 10...electrode, 11...insulator, 12...conductive layer, 15...screen printing mask, 16...adhesive paste, 17...squeegee, 18...insulating paste layer, 19...stuck-out portion, 20...IC card, 21...contact electrode terminal, 23...card substrate, 24...adhesive agent, 25...recess.